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November 3, 1992

DARPA/SISTO
Virginia Square Plaza
3701 N. Fairfax Drive
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Attn. Dr. Oscar Firschein

Subject: Quarterly Reports

Reference: Contract #MDA972-91-C-0053 titled "Representation and Recognition with Algebraic Invariants and Geometric Constraint Models".

Please find enclosed one copy of the above referenced report for the quarter ending June 1992. It is provided to you per the above referenced contract.

Please call if you have further questions.

Regards,

Thomas A. Viola
Contract Administrator

Enclosures

cc:

1. Defense Technical Information Center, Cameron Station, Attn: DTIC-FDAC, Alexandria, VA. 22304-6145 (two copies)
2. DARPA/SISTO
   3701 North Fairfax Dr., 7th Floor, Arlington, VA 22203-1714, Attn Edward R. Brown

Sponsored by
Advanced Research Projects Agency
Software & Intelligent System Technology Office
Representation and Recognition
With Algebraic Invariants and
Geometric Constraint Models
ARPA ORder NO. 8228
Program Code No. N/A
Contract No. MDA972-91-C-0053
March 1, 1992 - June 1, 1992

Progress

March 1, 1992 - June 1, 1992 Progress is summarized as follows:

- A new approach to the recognition of solids of revolution has been developed and demonstrated. The technique involves the construction of bi-tangents to the outline curve of the occluding boundary of the object. The intersection of these bitangent lines corresponds to the image of a point on the axis of revolution of the object. An invariant index can then be computed from four or more such points by using the standard cross ratio.

- Several new projective invariants have been developed for 3D geometric features including, four 3D lines, 6 3D points and 1 coplanar points with two additional points not on the plane. These invariants can be computed from two views of the object.

- A refinement of the theory of invariant model transfer has been developed, based on Lounget-Higgens work from the 1980's. A reformulation of the transfer process has been carried out by Richard Hartley which computes the essential matrix, Q, associated with the epipolar geometry of multiple views. This new formulation has lead to a more stable numerical algorithm for carrying out the transfer.

- The most recent version of our model-based vision system, using invariant indexing was presented as a live demonstration at the recent European Conference on Computer Vision in Italy in May. The system was able to reliably recognize objects from a database of about 30 objects. The objects, such as wrenches and machined brackets could be arranged by spectators and then the system carried out a recognition. The results were successful even with relatively high levels of occlusion.

- The IUE committee activities continue with further refinement and development of the specification. An important advance in the design has been formulated in terms of the concept of a *spatial object* which has the semantics of a point set. This concept has been successful in integrating many types of IU algorithm data structures.

Activities For Next Reporting Period

The planned activities are as follows:

- Experimentally evaluate the extraction of constraint-based models on the new RADIUS image data set of Fort Hood.
- Experimentally evaluate the new formulation of multiple view invariants.
- Complete the IUE specification and deliver to DARPA for the to support the preparation of a formal RFP.
- Extend the initial results on recognition of solids of revolution.

Equipment Purchased

None

Changes in Key Personnel

None

Summary of Information

Several papers documenting the work of CRD and CRD with other collaborators were presented at the European Conference on Computer Vision in May. This conference is highly selective and it was a good achievement to have four papers accepted.

Areas of Concern

Related Accomplishments

None